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Assessment of Forecast T-sums Using Model Output Statistics

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SUMMARY

The accuracy with which model output statistics (MOS) can be used to estimate weekly T-sums has been assessed. Comparisons have been made with raw model output, persistence and climatology, with MOS giving the lowest RMS errors of between 4 and 9 degree days in a week. This translates into MOS being 2 days or less out in the prediction of the date of T-sum 200 in 92% of T-sum squares covering Great Britain.

1. Introduction

The method of MOS has been used to calculate maximum and minimum temperatures each day for up to 6 days head. The calculations are made at about 140 stations in Great Britain. From these temperatures, daily averages are produced and added together to produce T-sums, negative averages being ignored. The station values are interpolated onto a 50 km x50 km grid of 126 squares, as shown in Figure 1.

T-sum forecasts are required for 7 days ahead and so persistence is used for the last day. In Farmer's Weekly these forecasts are required once a week, but on PRESTEL/FARMLINK it is possible to update the weekly forecast each day.

Figures will be presented showing errors in the T-sum forecasts during the early part of 1986. Particular attention is given by the farming community to the date at which T-sum 200 is reached, and so the analysis concentrates upon how well this was forecast. This analysis has been carried out on a weekly and daily basis to cover the two outlets. For comparison with the MOS forecast, weekly forecasts based on raw model output (T^*), persistence and climatology have also been prepared. It was not feasible to use manually produced forecasts in the comparison.

2. ANALYSIS

In Figure 2 the 4 methods of prognosis (MOS, T^*, persistence and climatology) are regressed against the actual value of weekly T-sum. Data are taken from the period January-April 1986. The comparative scatter on the graphs speaks for itself; clearly there is skill in the MOS forecast not present in the others.

This skill is quantified in Figure 3 where the RMS errors in the weekly MOS and persistence T-sums are displayed for each square. It can be seen that the MOS error is about half the persistence value in most squares. In only one square in southwest England is the persistence RMS error the smaller of the two.

The RMS errors in T-sums produced using T^* are of the same order as those for persistence in most squares. Last spring was cold, making the climatological errors even larger than those for persistence.

There are occasions (prolonged cold spells) early in the year when a small difference between the actual and predicted T-sum is transformed into a significant discrepancy between the predicted and actual day when the T-sum is reached. These times can occur when the T-sum is close to 200 and this explains why there are some anomalously large errors shown in Figures 4 and 5. They do not reflect any exceptional deficiency in the forecast at these locations, merely an unfortunate combination of events, which could happen in any square in any year. These errors are often rectified within a few days or the following week, as shown in Figure 12 for one of the poorer squares (125). Figure 4 illustrates the errors in MOS T-sums as perceived by a daily FARMLINK viewer, and Figure 5 the errors as perceived by a Farmers Weekly reader. Figures 6 and 7 for T^*, 8 and 9 for persistence and 10 and 11 for climatology have been included for comparison.

It should be noted when looking at these diagrams that no forecast can be more than one week (or seven days) late in predicting T-sum 200, because of the way in which the T-sums are updated with actual data. And so a -1 on the weekly maps indicates that the forecast method has failed to predict T-sum passing over 200 before it actually happens. When the errors are positive the forecast method has 'another chance' to get it right.

3. CONCLUSIONS

Of the methods tested MOS gives the lowest RMS errors in 50 km x 50 km T-sum estimates. This translates into MOS giving the smallest discrepancies in the estimation of the date when T-sum passes through 200.

However, the question still remains as to whether these values are good enough to present to the public. In 16 squares out of 126 (13%) the week of T-sum going over 200 is incorrectly forecast, and in 3 squares the error is greater than one week. On a daily basis the MOS prediction of T-sum 200 is not more than 2 days out in all but 10 squares.

If one looks just at those squares when T-sum 200 is not predicted one week ahead: MOS fails in 4 squares, T^* two, persistence 22 and climatology 54. It is on these occasions that users will feel the forecast has let them down most. Despite these promising figures for the model based forecasts, their over enthusiasm to predict T-sum 200 in certain squares cannot be ignored. However, although the user is apparently seriously mislead, the practical impact would be minimal because fertilizer spreading is not advised, and often not possible, in the very cold spells when the errors arose. After the cold spell, the forecast T-sums revert to a more normal level of error.

KEY WORDS:

Model output statistics, T-sums

Any comments or suggestions on this paper should be referred to the author.

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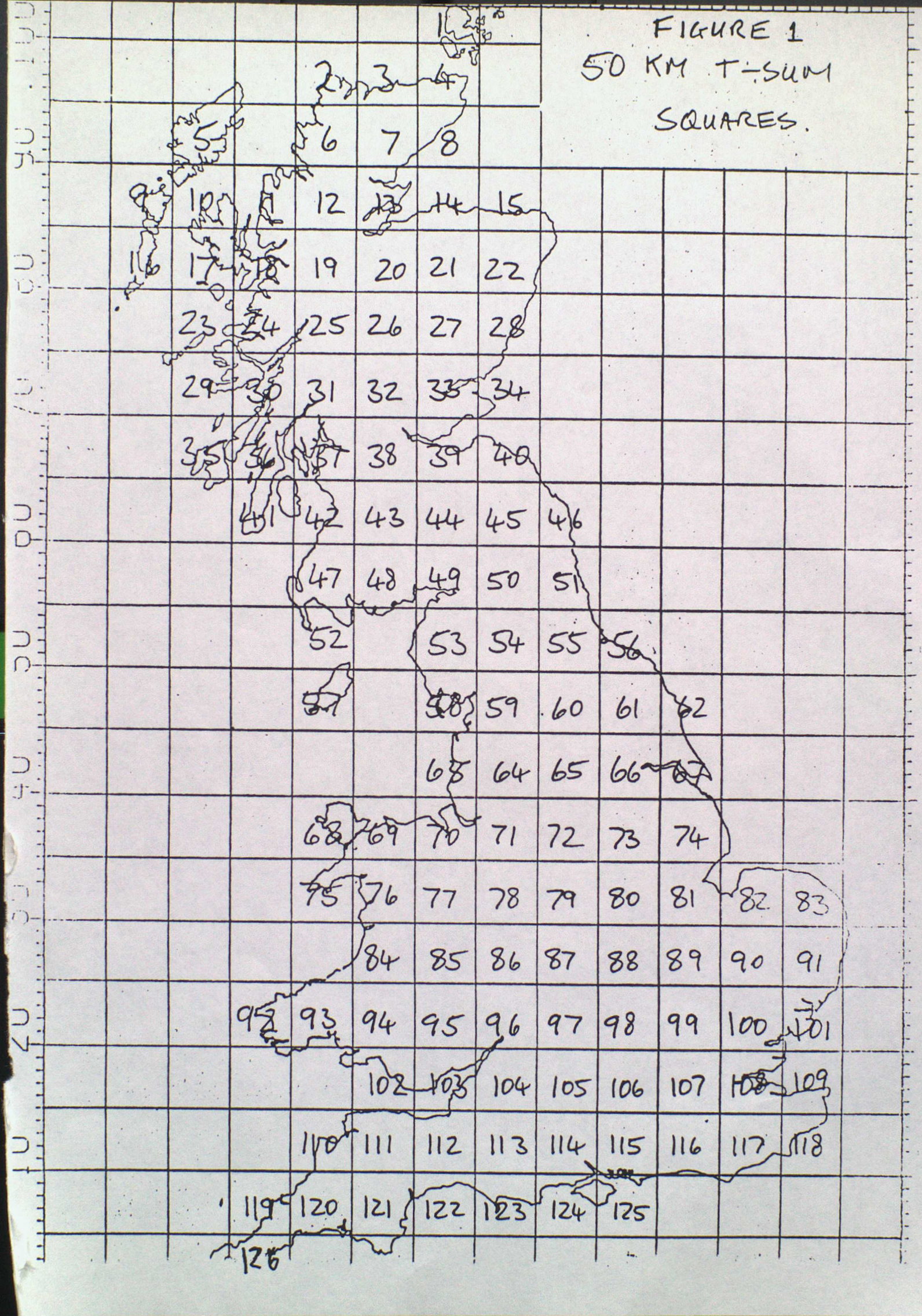


FIGURE 1
50 KM T-SUM
SQUARES.

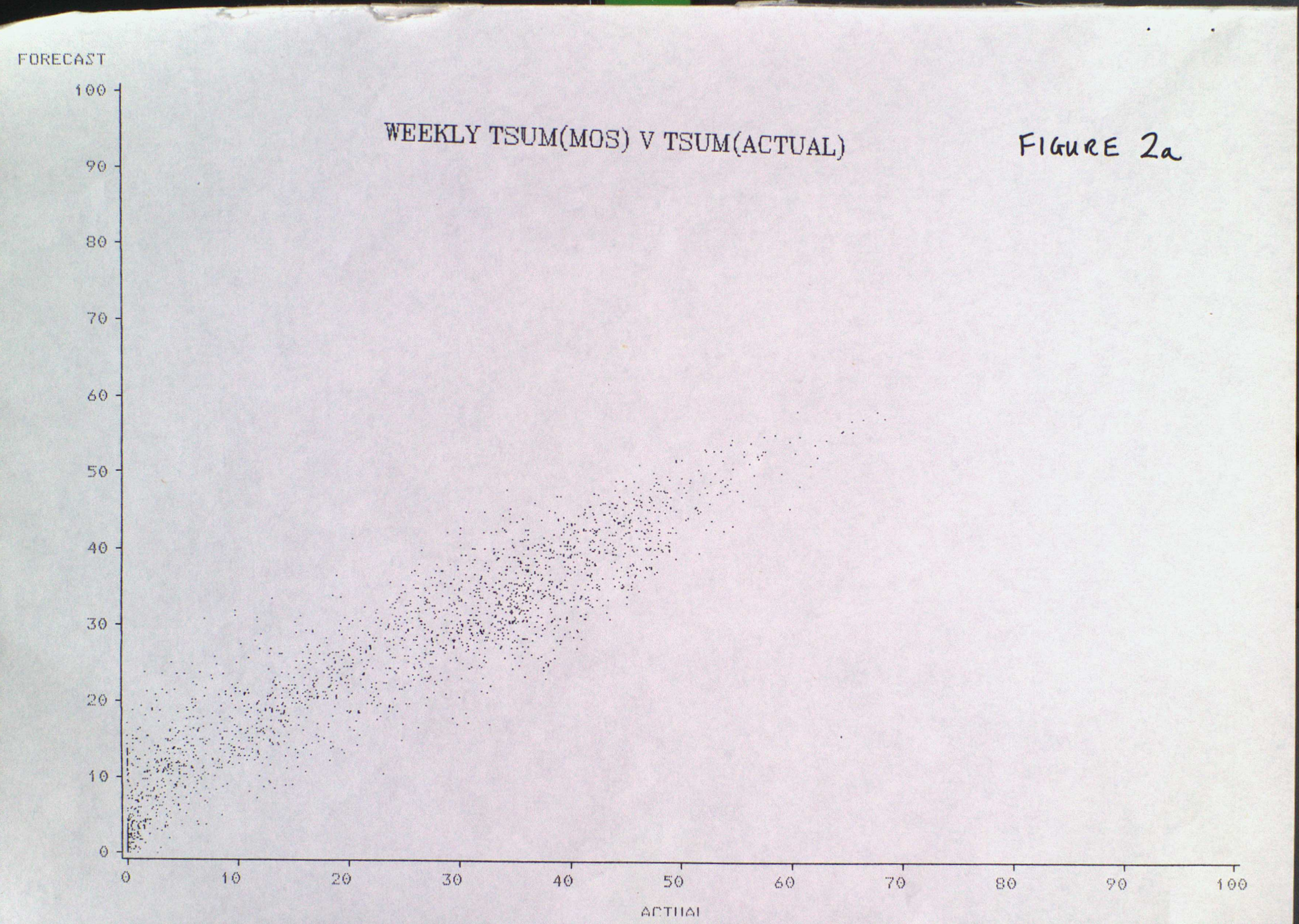
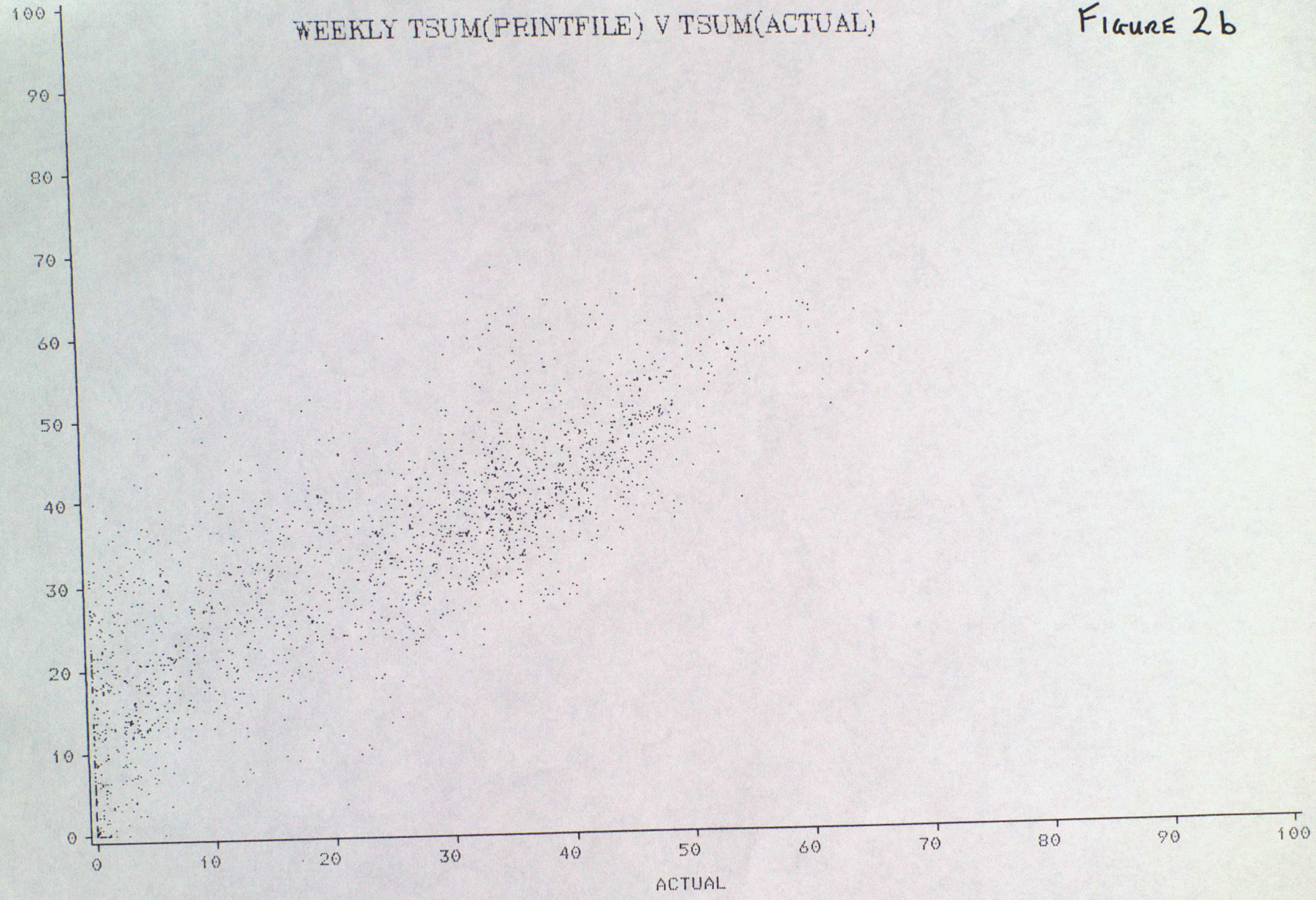

WEEKLY TSUM(MOS) V TSUM(ACTUAL)
FIGURE 2a
FORECAST
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
ACTUAL

FIGURE 2b


WEEKLY TSUM(PRINTFILE) V TSUM(ACTUAL)
FORECAST
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
ACTUAL

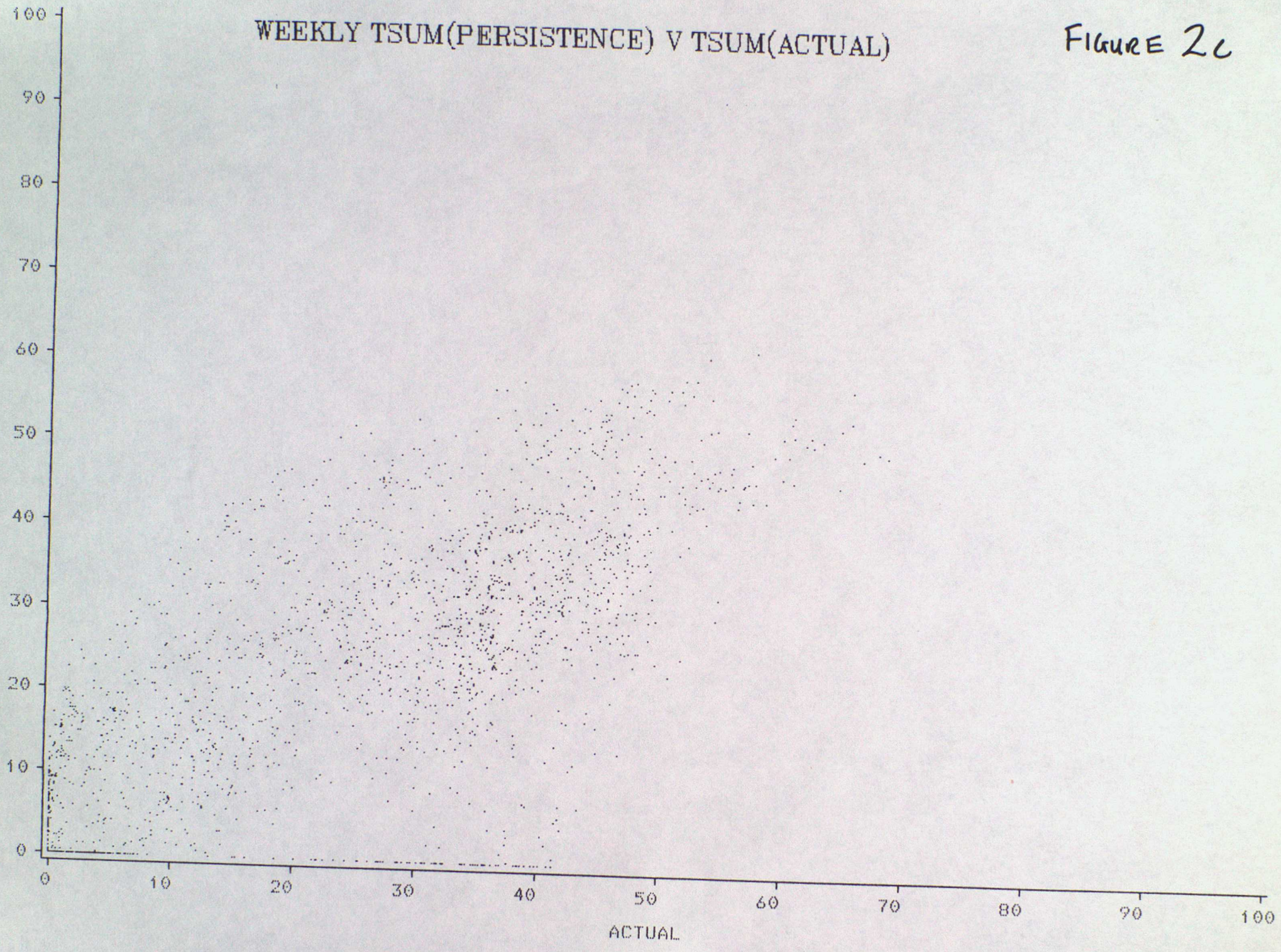

PERSIST
WEEKLY TSUM(PERSISTENCE) V TSUM(ACTUAL)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
ACTUAL

FIGURE 2c

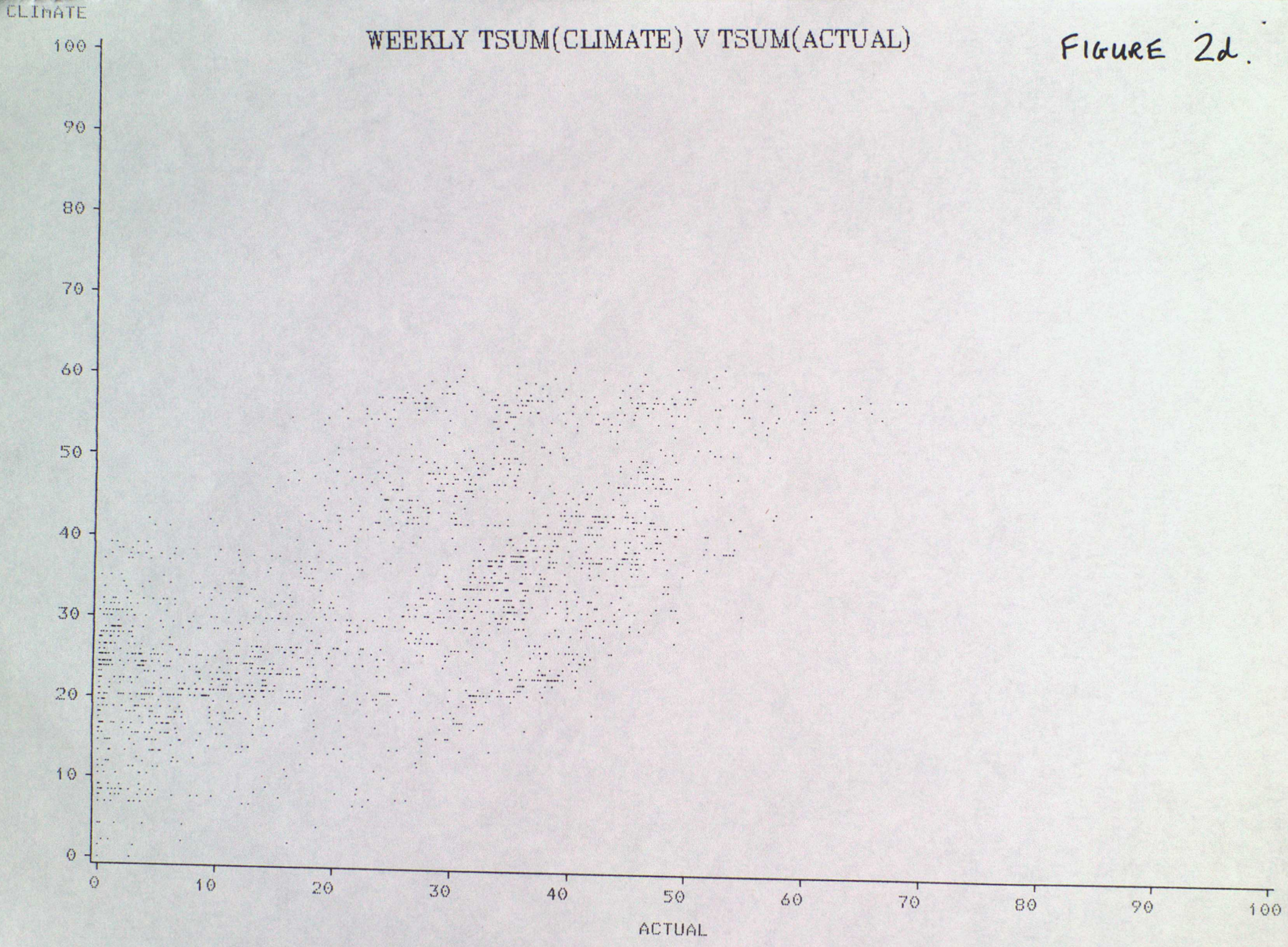
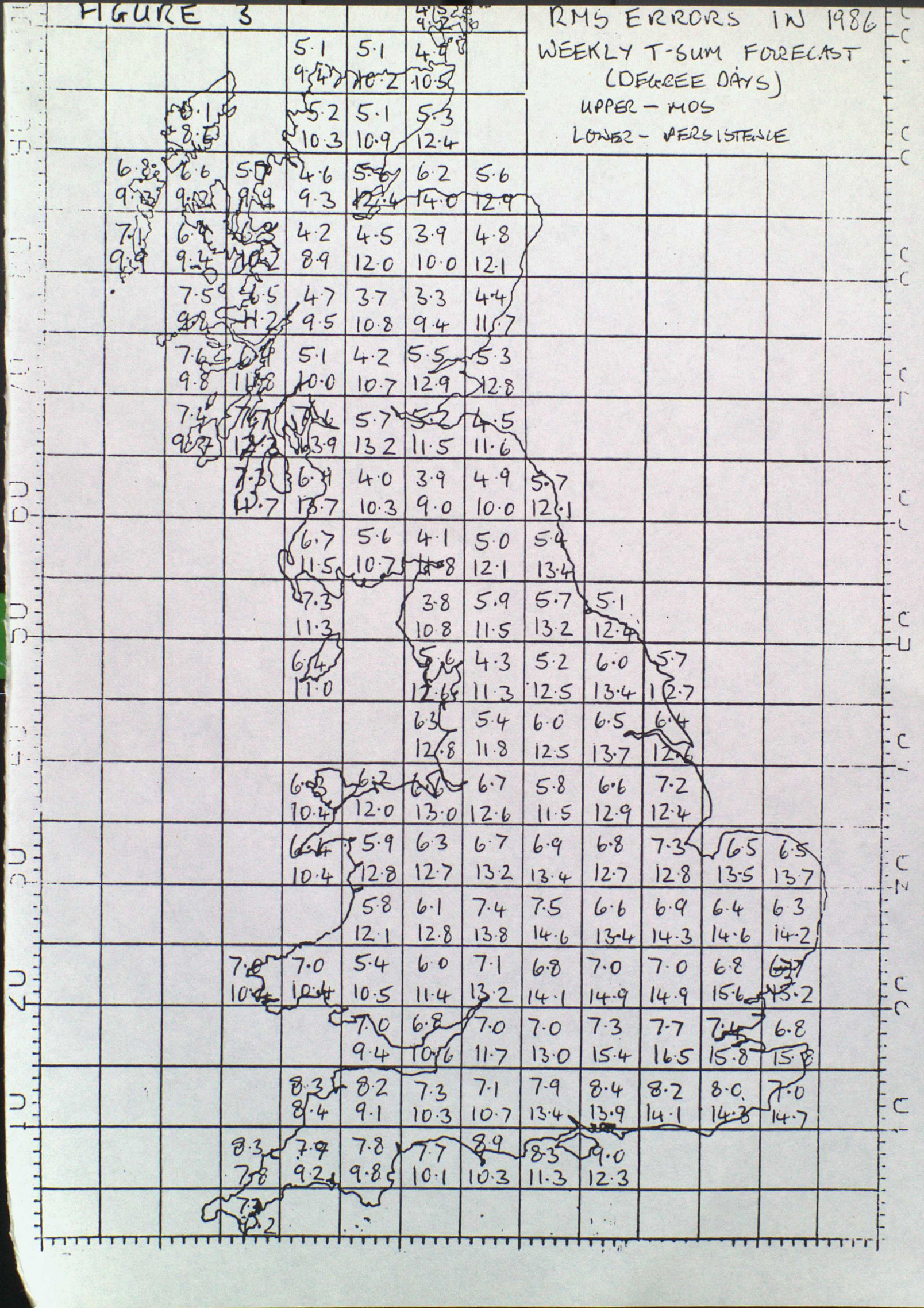

CLIMATE
WEEKLY TSUM(CLIMATE) V TSUM(ACTUAL)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
ACTUAL

FIGURE 2d.

FIGURE 3

RMS ERRORS IN 1986
WEEKLY T-SUM FORECAST
(DEGREE DAYS)
UPPER – MOS
LOWER – PERSISTENCE



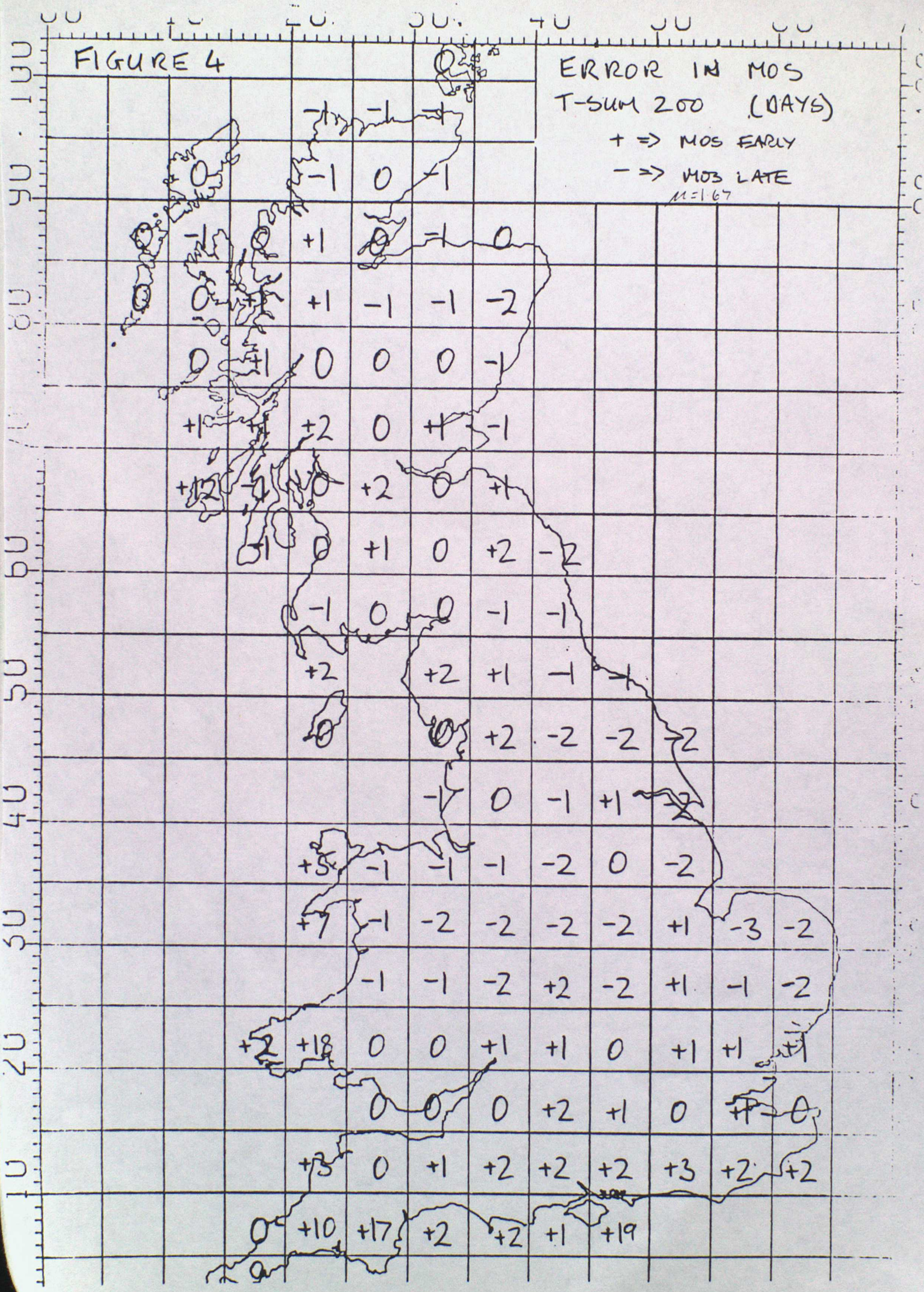


FIGURE 4
ERROR IN MOS
T-SUM 200 (DAYS)
+ => MOS EARLY
- => MOS LATE
M=1.67

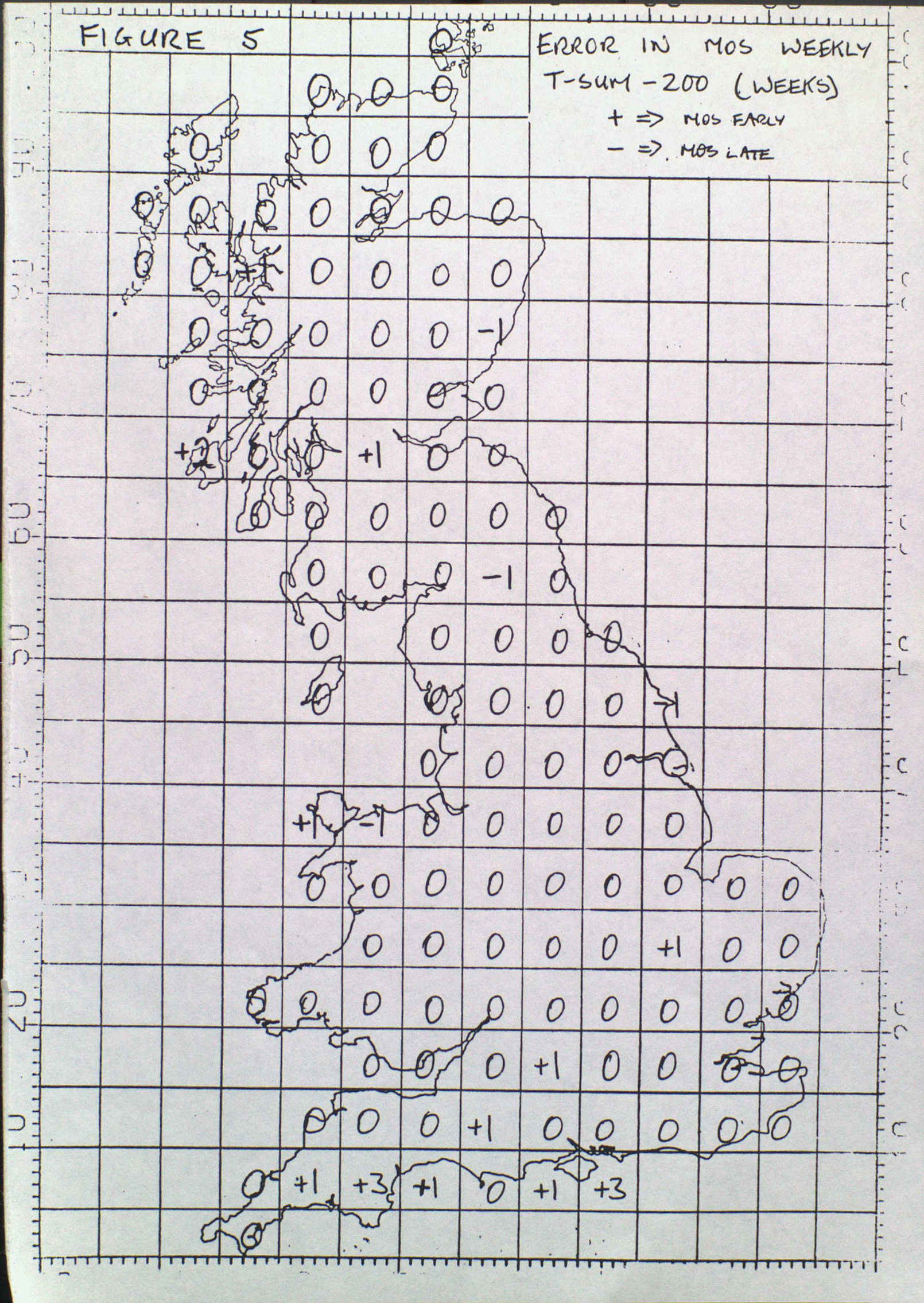


FIGURE 5
ERROR IN MOS WEEKLY
T-SUM -200 (WEEKS)
+ => MOS EARLY
- => MOS LATE
90
80
70
60
50
40
30
20
10

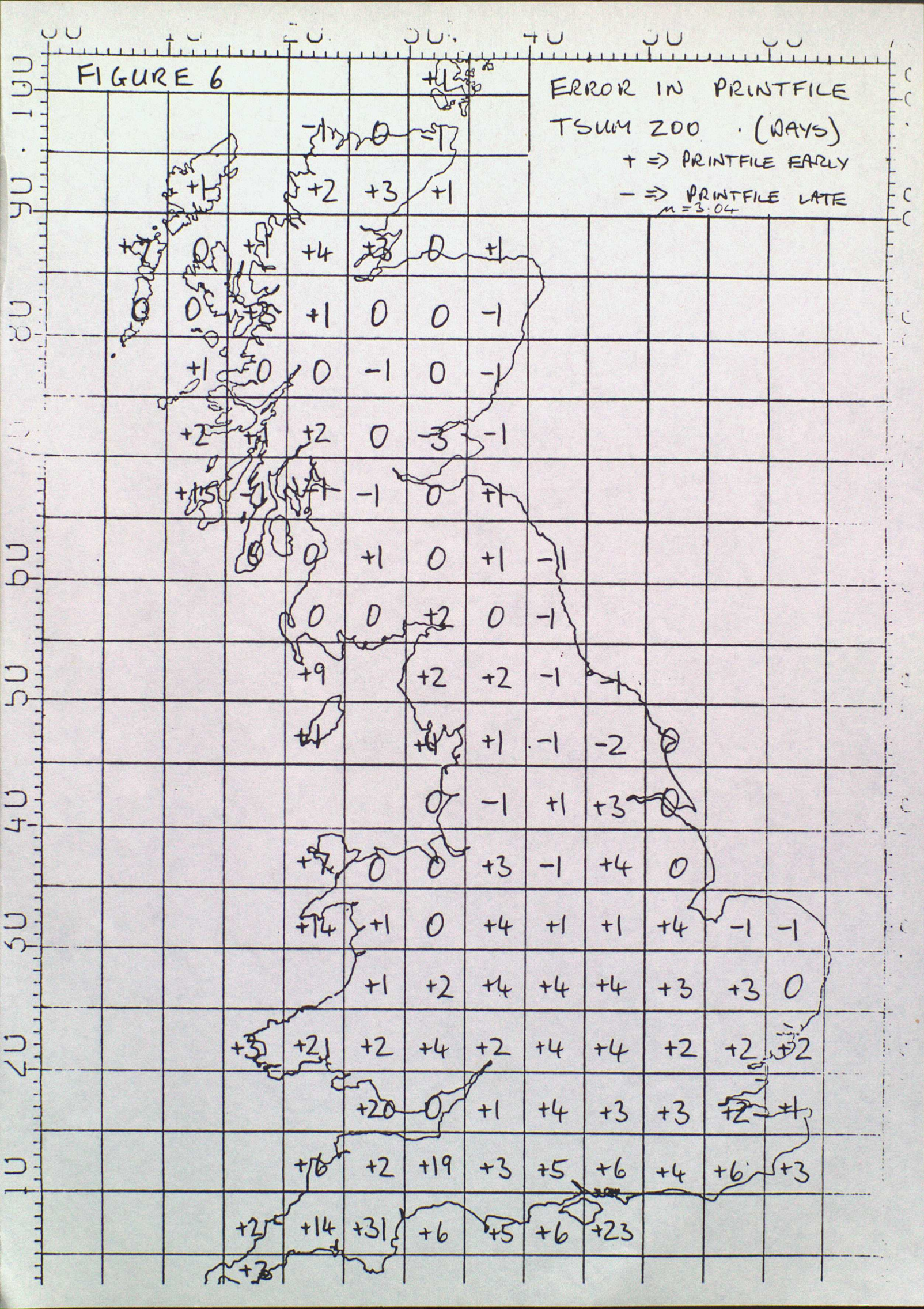


FIGURE 6
ERROR IN PRINTFILE
TSUM 200 . (DAYS)
+ => PRINTFILE EARLY
- => PRINTFILE LATE
m = 3.04

FIGURE 7

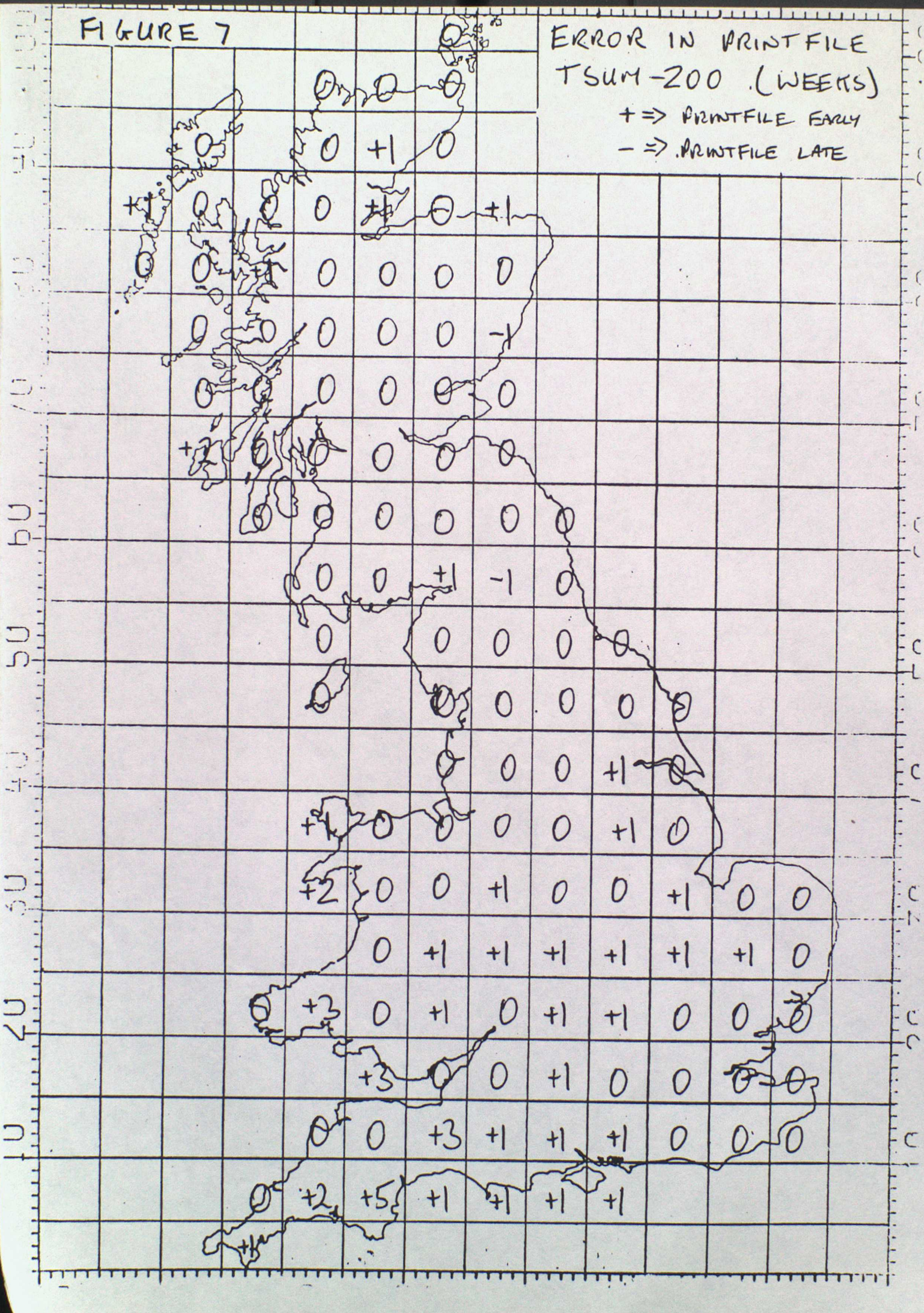

ERROR IN PRINTFILE
TSUM-200 (WEEKS)
+ => PRINTFILE EARLY
- => PRINTFILE LATE

FIGURE 8

ERROR IN PERSISTENCE
TSUM 200 (DAYS)
− ⇒ PERSISTENCE LATE
+ ⇒ PERSISTENCE EARLY

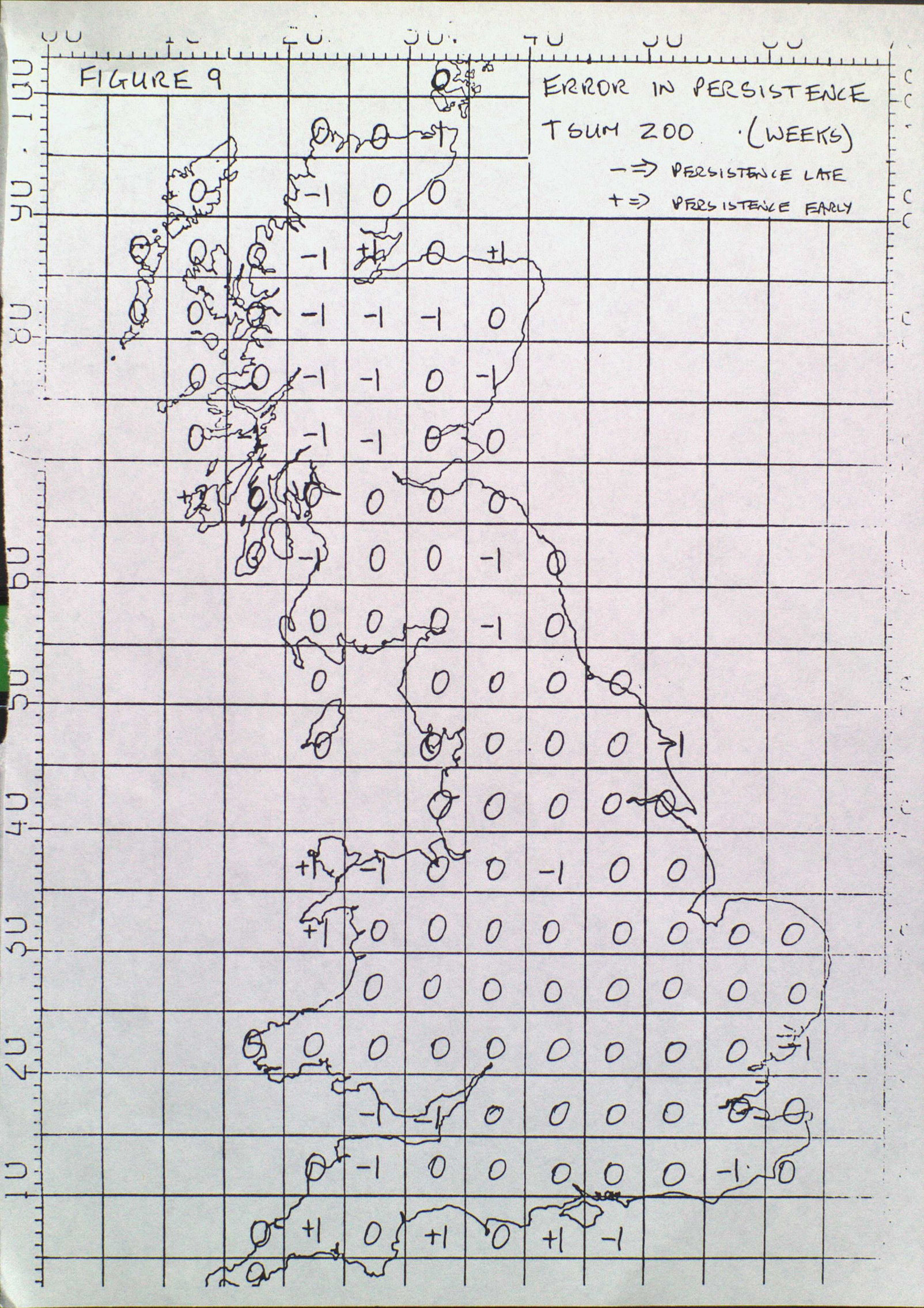


FIGURE 9
ERROR IN PERSISTENCE
TSUM 200 (WEEKS)
− ⇒ PERSISTENCE LATE
+ ⇒ PERSISTENCE EARLY

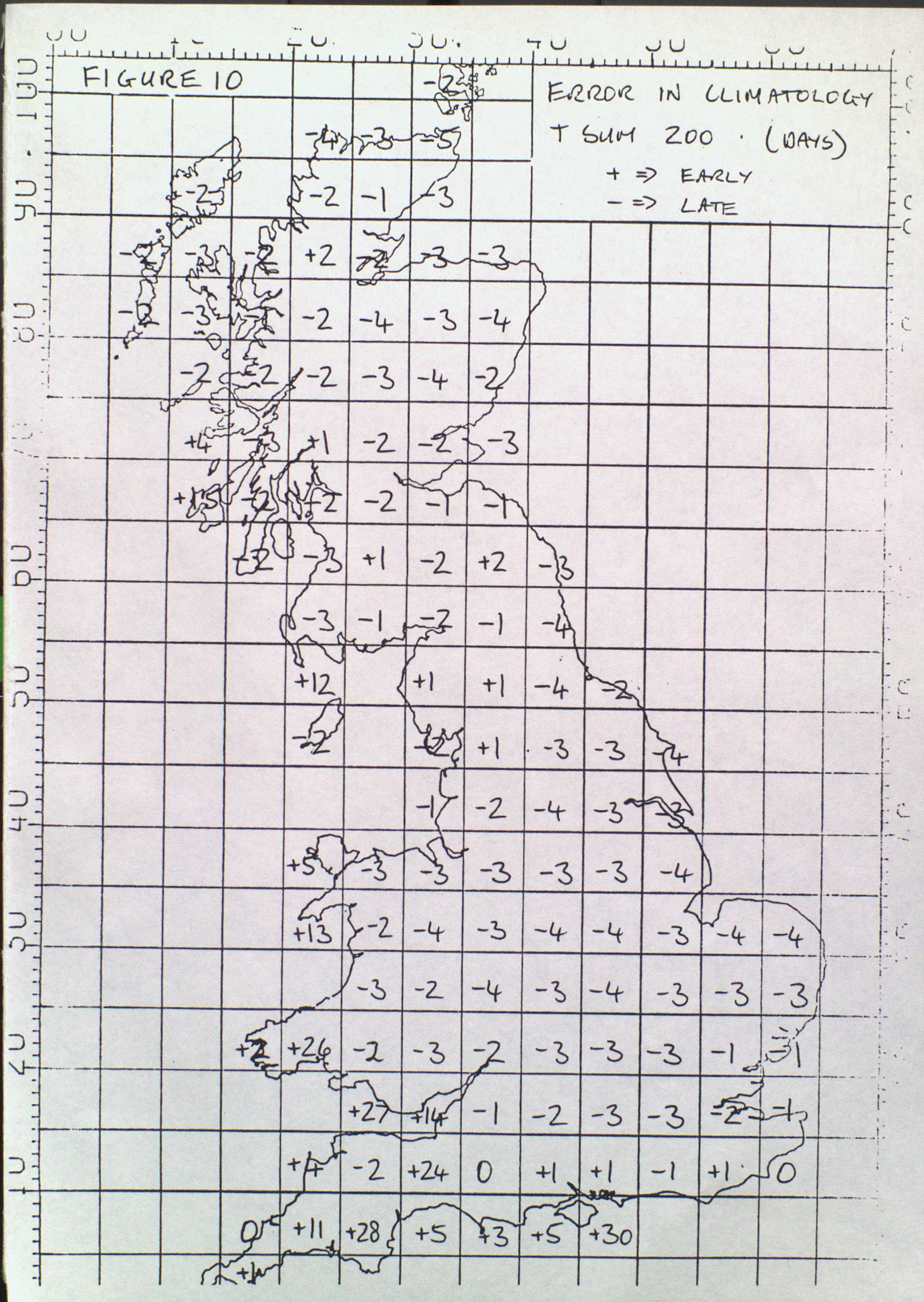


FIGURE 10
ERROR IN CLIMATOLOGY
T SUM 200 · (DAYS)
+ ⇒ EARLY
− ⇒ LATE

FIGURE 11

ERROR IN CLIMATOLOGY
T SUM 200 . (WEEKS)
+ ⇒ EARLY
− ⇒ LATE

FIGURE 12: MOS T-SUM FORECASTS FOR ONE WEEK AHEAD COMPARED WITH THE ACTUAL T-SUM FOR SQUARE No. 125